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AGRICULTURAL RESEARCH ADMINISTRATIONBUREAU OF ANIMAL INDUSTRY
COOPERATING WITH
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
AND THE
NEW MEXICO AGRICULTURAL EXPERIMENT STATION

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FIFTEENTH ANNUAL REPORT //
OF THE
SOUTHWESTERN RANGE AND SHEEP BREEDING LABORATORY
FORT WINGATE, NEW MEXICO
+

OCTOBER 31, 1951

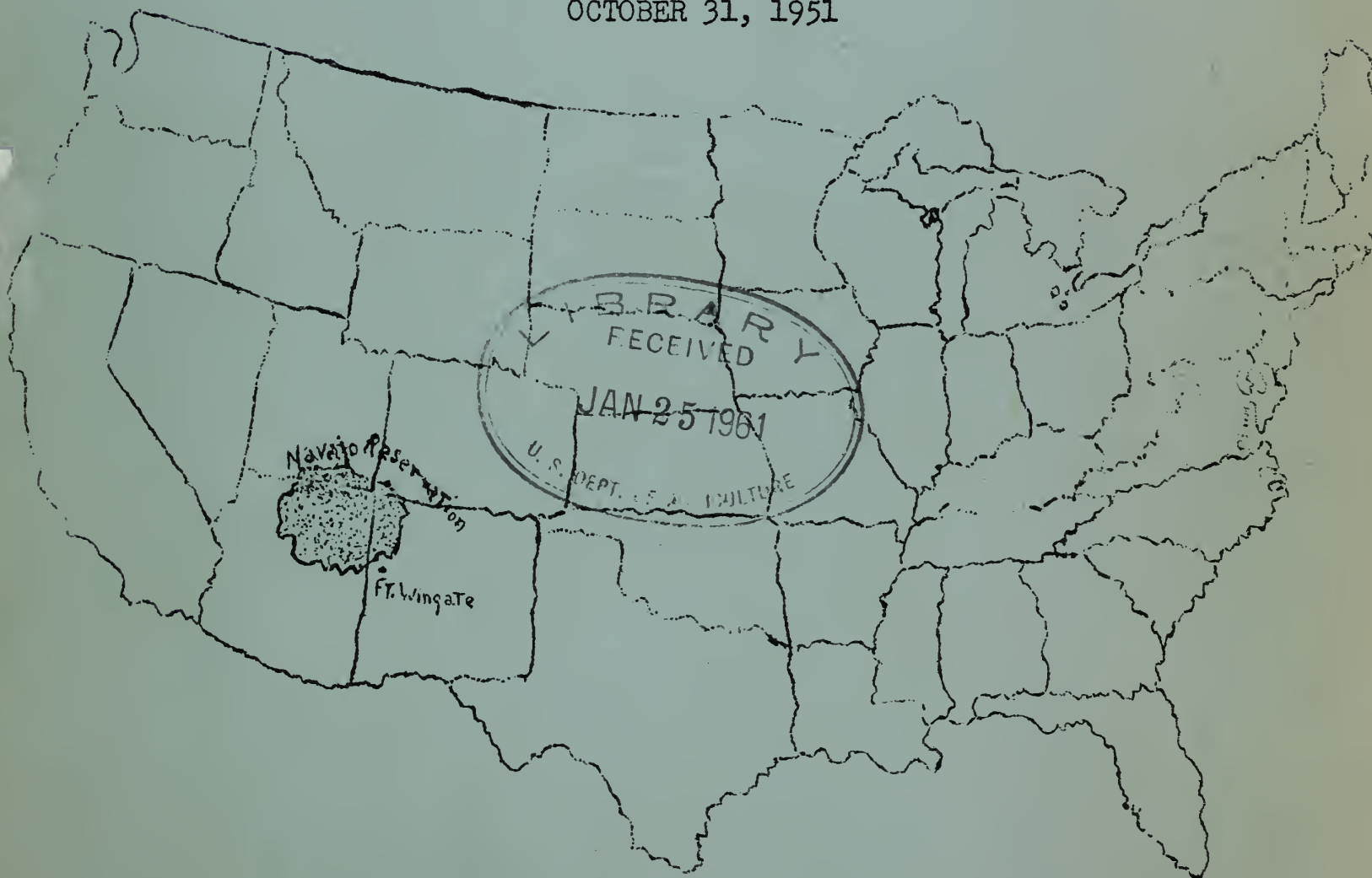
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Roster of Personnel

<u>Name</u>	<u>Title</u>	<u>Date entered on duty</u>	<u>Duties</u>
James O. Grandstaff	Animal Husbandman	Jan. 13, 1944	Director
George M. Sidwell ¹	Animal Husbandman	Dec. 1, 1946	Genetics
Glenn J. Spaulding ²	Animal Fiber Tech.	Aug. 1, 1949	Wool Invest- igations
Donald A. Price	Animal Husbandman	Mar. 21, 1949	Sheep Invest- igations
Gene L. Oakes ³	Animal Husbandman	July 3, 1950	Sheep Manage- ment
Vern B. Swanson	Animal Husbandman	Apr. 10, 1951	Sheep Manage- ment
Marian A. Battese ⁴	Clerk-Stenographer	July 1, 1950	Clerical
Alison S. Dodge	Clerk-Stenographer	June 3, 1951	Clerical
Lulu F. Henerson ⁵	Statistical Clerk	July 1, 1950	Sheep Records
Jimmie Gleason	Janitor	Apr. 1, 1942	Janitor and Miscellaneous
Marion Chadacloi	Laboratory Aid	Jan. 12, 1944	Miscellaneous
Alfred Dempsey	Agricultural Aid	Dec. 23, 1945	Miscellaneous
Fred Deschene	Agricultural Aid	Oct. 2, 1947	Miscellaneous
Calvin Gleason ⁶	Agricultural Aid	June 14, 1951	Miscellaneous

1 Began Leave without Pay September 14, 1951.

2 Terminated by Reduction in Force order September 30, 1951.

3 Resigned January 22, 1951.

4 Resigned May 25, 1951

5 Terminated by Reduction in Force order September 30, 1951.

6 Terminated by Reduction in Force order October 12, 1951.

OBJECTIVE

The main objective of this laboratory is the development of types of sheep which are adapted to the semi-arid range conditions of the southwest, and to the economic requirements of Navajo Indians and other sheepmen of this area. In the pursuit of this objective, basic breeding methods are employed, utility values of the wool are studied, and the selection of breeding animals is based upon production as measured under range environment. Emphasis is placed primarily on adaptability and longevity of the sheep, yield of wool and its suitability with respect to hand weaving and commercial manufacture, and the quantity and quality of lambs produced.

OUTLINE OF RESEARCH PROGRAM

In order to achieve the above objective, in the development of breeds and strains of sheep suitable to the southwestern ranges and to the economic requirements of the sheepmen, there are four active research projects under way. These projects are listed as follows:

1. Improvement of Navajo sheep by linebreeding and selection in the Navajo strain.
2. Improvement of Navajo sheep by crossbreeding and selection for the production of wool suitable for both hand and commercial methods of manufacture.
3. Improvement of Navajo sheep by crossbreeding and selection for range production of wool and lambs.
4. Development of an efficient method of selecting animals used in the program of the Southwestern Range and Sheep Breeding Laboratory.

(NOTE: When reference is made to the above projects in the following sections of this report, only the number preceding the project title will be used.)

Research and Marketing Act Project:

RM-a-427-4 I Subtitle (BAI) Evaluation of wool from sheep, goats and rabbits with respect to fabrication, felting and insulation values. Line project title: Properties of blanket and rug wools of known genetic origin and history in relation to their use in fabrication, felting and insulating values.

PUBLICATIONS

The following papers have been published since the establishment of the Southwestern Range and Sheep **Breeding** Laboratory:

1. The Navajo Sheep Industry and Needs for Its Improvement:
J. M. Cooper, the Sheep Breeder, May 1939.
2. The Sheep Industry of Indians in the Southwest:
J. M. Cooper and Dewey Dismuke, Indians At Work, August 1939.
3. Breeding for Adaptability to Local Conditions, with Special Reference to Sheep on the Navajo Indian Reservation:
J. M. Cooper, American Society of Animal Production, 1939.
4. Improvement of the Navajo Sheep:
Cecil T. Blunn, Journal of Heredity, March 1940.
5. Breeding for Quality Wool:
James O. Grandstaff, The National Wool Grower, July 1940.
6. A Rapid Method for Projecting and Measuring Cross Sections of Wool Fibers:
James O. Grandstaff and Walter L. Hodde, Circular No. 590, U. S. Department of Agriculture, December 1940.
7. Evaluating Fleece Characteristics of Navajo Sheep from a Breeding Standpoint:
James O. Grandstaff, Rayon Textile Monthly, October-November 1941.
8. Wool Characteristics in Relation to Navajo Weaving:
James O. Grandstaff, Technical Bulletin No. 790, U. S. Department of Agriculture, January 1942.
9. Characteristics and Production of Old-Type Navajo Sheep:
Cecil T. Blunn, Journal of Heredity, May 1943.
10. The Influence of Seasonal Differences on the Growth of Navajo Lambs:
Cecil T. Blunn, Journal of Animal Science, February 1944.
11. A Preliminary Report on the Post-natal Development of the Fiber Characteristics of the Fleeces of Navajo Sheep:
James O. Grandstaff and Cecil T. Blunn, Journal of Animal Science, May 1944.
12. Comparison of the Yields of Side Samples from Weanling and Yearling Sheep:
Cecil T. Blunn and James O. Grandstaff, Journal of Animal Science, May 1944.
13. Yearly Differences in Growth of Navajo and Crossbred Ewe Lambs:
Cecil T. Blunn, Journal of Animal Science, August 1945.

14. Evaluating Fleece Quality of Navajo Sheep from Small Samples:
James O. Grandstaff and Cecil T. Blunn, Journal of Agricultural Research, September 1945.
15. Improvement of Wool for Navajo Hand Weaving:
James O. Grandstaff and Cecil T. Blunn, Indians at Work, March 1945
16. Relation of Kemp and Other Medullated Fibers to Age in the Fleeces of Navajo and Crossbred Lambs:
James O. Grandstaff and Harold W. Wolf, Journal of Animal Science, May, 1947.
17. Comparison of Corriedale x Navajo and Romney x Navajo Crosses:
James O. Grandstaff, Journal of Animal Science, November 1948.
18. Size of Lambs at Weaning as a Permanent Characteristic of Navajo Ewes:
George M. Sidwell and James O. Grandstaff, Journal of Animal Science, August 1949.
19. Adaptation of Livestock to New Environments: James O. Grandstaff, for publication in Proc. United Nations Scientific Conference on Conservation and Utilization of Resources, Lake Success, New York, 1949.
20. Fertility and Reproduction in Sheep in Relation to Breeding and Environment:
James O. Grandstaff, presented at International Symposium on High Altitude Biology held at Lima, Peru, South America, November 23-30, 1949.
21. Genetic and Environmental Factors Affecting Staple Length in Navajo and Navajo Crossbred Weanling Lambs:
George M. Sidwell, James O. Grandstaff and Donald A. Price, Journal of Animal Science, February 1951.
22. Lamb Production of Navajo Ewes Bred to Columbia and Romney Rams, and Navajo Crossbred Ewes Bred to Lincoln and Cotswold Rams:
Donald A. Price, James O. Grandstaff and George M. Sidwell, Journal of Animal Science, February 1951.
23. Genetic and Environmental Factors Affecting Type and Condition in Navajo and Navajo Crossbred Weanling Lambs:
George M. Sidwell, Donald A. Price and James O. Grandstaff, Journal of Animal Science, May 1951.

SUMMARY OF PRECIPITATION

Year	Precipitation in Inches												Total
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
1864-1911	.96	1.42	1.02	.98	.58	.69	2.34	2.31	1.37	1.05	.76	.97	14.45
1938	.52	.79	1.95	.43	.61	1.67	.78	1.84	.85	.10	.67	.24	10.47
1939	1.96	.62	.64	1.57	.29	Tr.	.85	1.23	1.31	.30	.10	1.22	10.09
1940	.76	.53	.59	.53	.61	1.00	.48	1.92	2.05	2.15	.89	2.14	13.65
1941	.89	1.12	1.80	1.46	2.10	.76	.71	1.75	4.05	2.40	.73	.70	18.47
1942	.33	1.04	.75	.96	.00	.00	.64	1.87	1.31	1.71	.15	1.17	9.93
1943	1.48	.24	1.61	.46	.28	.41	2.30	1.94	.30	1.65	Tr.	.88	11.55
1944	.64	.71	1.07	.21	.87	.14	1.10	1.91	.99	1.49	.93	1.42	11.48
1945	.72	.25	.96	.44	.05	.21	2.70	3.63	.05	1.78	.00	2.03	12.82
1946	.49	.07	.25	.72	Tr.	.05	2.22	4.89	1.98	.65	1.51	.46	13.29
1947	.48	.10	.12	Tr.	2.08	.41	1.31	4.32	.76	1.22	1.17	.57	12.64
1948	.24	1.19	1.15	.13	.58	1.09	2.38	2.23	1.14	.69	.17	1.64	12.63
1949	1.33	.50	.53	.23	.39	.80	2.13	1.53	1.53	.82	.00	.95	10.74
1950	.63	1.01	.17	.00	.02	.25	1.52	.56	1.24	.00	.52	.14	6.06
1951	1.26	.56	.20	.84	.53	.02	1.58	1.84	.71	.86	.69	1.17	10.26
1933-1950	.81	.63	.89	.55	.61	.52	1.47	2.28	1.35	1.15	.53	1.04	11.83

The preceding table summarizes the precipitation at Fort Wingate, New Mexico for the 47-year period, 1864-1911, and for individual years from 1938 to 1951, inclusive. In 1951, the total precipitation of 10.26 inches was 13.27 percent below the average of the preceding 13 years, and 29.0 percent below the 47 year average.

Range Operations and Emergency Measures During the Drought Period

The drought of 1950, the most severe on record for northwestern New Mexico, resulted in an acute shortage of range forage and water with adverse effects on wool and lamb production for that year. For this reason the entire laboratory flock was shipped, on September 28, 1950, to a ranch near Towner, Colorado for wintering.

The 1951 lambing was almost complete at Towner when a heavy hail storm and flood hit the flock and killed some 235 ewes and 550 lambs. The flock was quite some time in recovering from the shock with the result that many of the ewes ceased to care for their lambs. Meanwhile, precipitation on the Laboratory range in New Mexico did not come in June. The flock had to be moved from Towner due to the presence of Spanish needle grass. As no suitable range was available in that area, the flock was returned to Fort Wingate where the sheep were maintained in the feed lot from June until August 1, at which time the range forage had begun to improve. The sheep were then moved to the El Morro range where they remained until breeding in December, at which time they were moved back to the Laboratory headquarters. The effects of the hailstorm, the trip from Kansas and maintenance in the feed lot resulted in a very low percent of lambs weaned from ewes lambing, a 40 percent below normal weaning weight and very few lambs kept for replacement purposes. A review of sections of this report pertaining to lamb production will reveal influence of these environmental conditions.

Precipitation in August and September, 1951 was below normal and the range feed failed to make sufficient growth to produce the quantity of forage needed to carry the flock through late winter and early spring. For this reason, the ewe and lamb herds were shipped to Topock, Arizona on January 10, 1952, where desert forage was plentiful.

Observations on Loss of Government Sheep by Hail
and Flood at the L. E. Trued Ranch, Towner, Colorado

Ewes and lambs were distributed in small flocks on all areas of the ranch on May 29, 1951. The rams were in a pasture on the extreme West corner of the range. The major portion of the lambing operations, which began about May 5, were essentially completed.

At 9:00 P.M. on the evening of May 29th, it appeared that the country to the Northwest was getting a good shower. Showers had been a common thing in the previous two weeks. Sometime around 9:00, the R. E. A. electricity went off and a minute or so before the hail struck, a roar was heard. Then, hail broke all North, West and East windows in the Trued house and buildings surrounding headquarters. Trees were denuded, siding on houses, barns and windbreaks hammered, windbreaks blown down by the terrific wind and corrals washed by rain of cloudburst proportions which followed the hail.

Immediately after the hail ceased, all hands were called to save ewes, in a corral south of the barn, which had been driven by the hail into the south corner of the corral. The sheep were standing in water to their sides against a woven wire fence. The White Woman Creek was running high up to and in the corral. A fog settled on the area after the rain and visibility was about twenty feet. It was necessary to handle all sheep individually in order to start them to the safety of the barn so they would not chill any more, or break the fence that they were wedged against, and wash down to the creek. This operation of moving sheep lasted about three hours. Then, because all hands were greatly fatigued and chilled, it was deemed necessary to cease work till daylight. At 4:00 A.M., Mr. Trued, Mr. Swanson and myself made the rounds of the various bands of sheep. The destructive hail, the average size of golf balls, had not spared the sheep. In a later, more accurate count, 553 lambs and 235 ewes were killed by either hail, or hail and flood, or by trampling one another caused by the chaos of the storm. No roads in any direction were open, so Mr. Swanson forded the creek and got a ride to Towner and informed Mr. Grandstaff of the loss and told him a veterinarian should be called.

The rams, a mile West of the corral where great loss was suffered to ewes and lambs, were not harmed.

Donald A. Price
Animal Husbandman

OUTLINE OF BREEDING PROGRAM FOR 1950-51 BREEDING SEASON

Number of Breeding Group	Breeding of Rams		Breeding of Ewes	Approx. No. of Ewes
1	N	x	N	156
8	$C_2 \times \left(\begin{smallmatrix} C_1 & \times & N \\ R_1 & \times & N \end{smallmatrix} \right) \times \left(\begin{smallmatrix} R_1 & \times & N \\ C_1 & \times & N \end{smallmatrix} \right)$	x	K x N	165
9	K x N	x	$C_2 \times \left(\begin{smallmatrix} C_1 & \times & N \\ R_1 & \times & N \end{smallmatrix} \right) \times \left(\begin{smallmatrix} R_1 & \times & N \\ C_1 & \times & N \end{smallmatrix} \right)$	123
10	$R_1 \times N$	x	$L \times \left(\begin{smallmatrix} C_1 & \times & N \\ R_1 & \times & N \end{smallmatrix} \right) \times \left(\begin{smallmatrix} R_1 & \times & N \\ C_1 & \times & N \end{smallmatrix} \right)$	146
11	$L \times \left(\begin{smallmatrix} C_1 & \times & N \\ R_1 & \times & N \end{smallmatrix} \right) \times \left(\begin{smallmatrix} R_1 & \times & N \\ C_1 & \times & N \end{smallmatrix} \right)$	x	$R_1 \times N$	116
12	T	x	$\left(\begin{smallmatrix} C_1 & \times & N \\ R_1 & \times & N \end{smallmatrix} \right) \times \left(\begin{smallmatrix} R_1 & \times & N \\ C_1 & \times & N \end{smallmatrix} \right)$	205
13	$R_2 \times N$	x	$\begin{matrix} T \\ D \\ M \end{matrix} \times \left[\begin{smallmatrix} C_1 & \times & N \\ R_1 & \times & N \end{smallmatrix} \right] \times \left(\begin{smallmatrix} R_1 & \times & N \\ C_1 & \times & N \end{smallmatrix} \right)$	35
15	R_2	x	N	156
16*	$\left[K \times N \right] \times \left[C_2 \times \left(\begin{smallmatrix} C_1 & \times & N \\ R_1 & \times & N \end{smallmatrix} \right) \times \left(\begin{smallmatrix} R_1 & \times & N \\ C_1 & \times & N \end{smallmatrix} \right) \right]$	x	$\left[C_2 \times \left(\begin{smallmatrix} C_1 & \times & N \\ R_1 & \times & N \end{smallmatrix} \right) \times \left(\begin{smallmatrix} R_1 & \times & N \\ C_1 & \times & N \end{smallmatrix} \right) \right] \times \left[K \times N \right]$	
TOTAL				1167

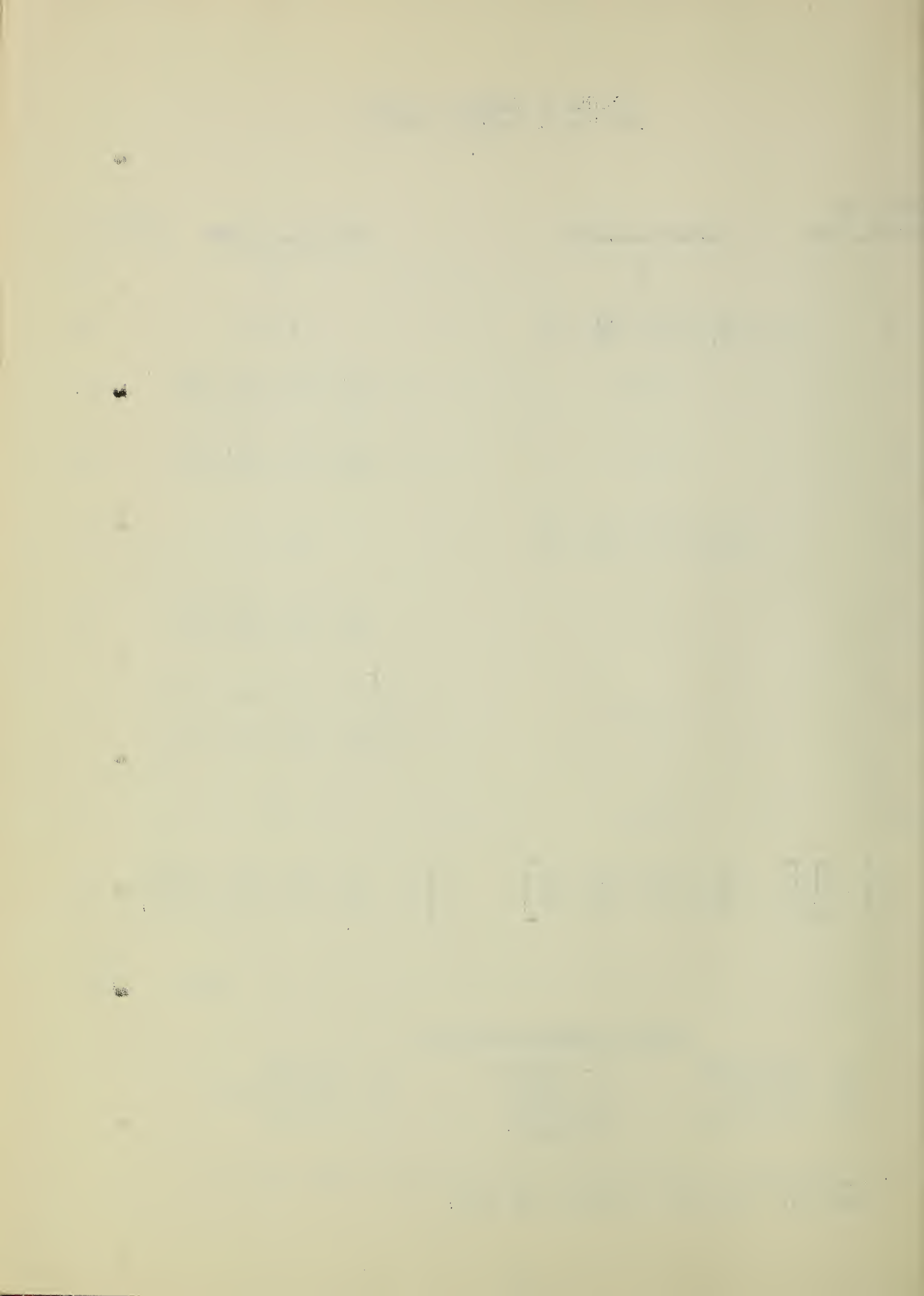
Code of Symbols for Breeds

C_1 - Corriedale
 C_2 - Cotswold
D - Debouillet

K - Columbia
L - Lincoln
M - Merino
N - Navajo

R_1 - Romney
 R_2 - Rambouillet
T - Targhee

* The breeding of the rams may be the reciprocal of that shown in Group 16. The same is true for the ewes.



SUMMARY OF BREEDING PROGRAM

The breeding flock for the 1950-1951 season consisted of 1167 ewes in the regular groups, plus 118 for assignment to test pens, making a total of 1285 breeding ewes. This is essentially the same number as were bred during the 1949-1950 season.

The various breeding groups were associated with the research line projects as follows:

<u>Breeding Group</u>	<u>No. of Matings</u>	<u>Research Project No.</u>
1	156	1
8, 9, 10, 11, 16	615	2
12, 13, 15	396	3

The total number of full-blood Navajo ewes available for breeding was 312, a decrease of 13.3 percent from the previous year. Culling of Navajo ewes has been held to a minimum during the past few years because of the small number of replacement ewes produced. Many ewes 8 to 12 years of age have been retained for breeding in order to obtain maximum lifetime production of lambs. This procedure proved satisfactory in years of normal precipitation and range conditions, but with severe drought conditions in 1950 and 1951, ewe losses have been high. Moreover, in view of the large expense involved in wintering the Laboratory sheep at Towner, Colorado, it seemed advisable to cull the aged Navajo and crossbred ewes more heavily than would have been necessary under normal conditions.

Of the 312 Navajo ewes remaining, 156 were bred to Navajo rams (Group No. 1) and 156 to Rambouillet rams (Group No. 15).

Groups 6 and 7 were discontinued in 1950. Ewes from these groups having satisfactory fleece characteristics and an inheritance of 1/2 Navajo, 1/4 Romney, and 1/4 Corriedale were transferred to group 12.

In group 8, 165 F₁ Columbia x Navajo ewes were mated to Cotswold cross rams originating from group 7. The 123 matings in group 9 form the reciprocal of those in group 8.

In group 10, 148 Lincoln cross ewes were mated to F₁ Romney x Navajo rams. The ewes in this group are the offspring from group 6 matings. The 116 matings in group 11 were the reciprocal of those in group 10.

The ewes and rams of group 16 are the progeny of matings described for groups 8 and 9. This breeding group is the final cross in one phase of research project 2.

Group 12, one of the three groups associated with research project 3, was composed of 205 crossbred ewes carrying an inheritance of 1/2 Navajo, 1/4 Romney and 1/4 Corriedale. These ewes were mated to Targhee rams.

Summary of Breeding Program, continued.

In group 13, 35 F₁ Targhee, Debouillet and Merino cross ewes were mated to F₁ Rambouillet x Navajo rams.

Group 14 was discontinued in 1950.

Group 15 matings consisted of 156 Navajo ewes mated to Rambouillet rams.

Progeny Testing of Purebred Rams

In addition to the regular breeding groups described above, 118 ewes were divided at random into four test pens of about equal numbers. Two Rambouillet and two Targhee rams were used in these pens. The test pen ewes originated from previous test pen matings or range breeding. The progeny of each ram was evaluated so as to obtain a record of his breeding performance.

MEASUREMENT OF BODY WEIGHTS, SCORES, FLEECE CHARACTERISTICS AND SELECTION PROCEDURE

In 1951, the lambs were born during the month of May on leased facilities near Towner, Colorado. They were weaned September 10 at approximately 120 days of age. At weaning time, each lamb was weighed individually and this weight recorded to the nearest pound. Face covering, type, condition and outercoat scores were taken by a committee of three experienced animal husbandmen, working independently. Also, color scores and degree of horn development were recorded.

Small fleece samples collected from the middle of the left side and the thigh of each lamb at weaning age were used for measurements of their fiber characteristics. Average fiber diameter and percentages of kemp and other medullated fibers at side and thigh were determined from magnified cross-sections of the fibers, by the rapid count method. Staple length measurements were also made on the side samples. The period of wool growth was statistically adjusted to a constant age of 120 days.

Culling of the weanling lambs was done in October. The lambs were sorted by sex into their respective breeding pens to facilitate the work of selection. The lambs of each pen were considered individually for all traits evaluated at weaning time. Also, each pen of lambs was scored as a group for size, type, condition, face covering, and fleece quality and for uniformity in these characteristics. The degree of selection practiced on each pen of lambs depended upon the individual merit of the lambs and the quality and uniformity of the pen of lambs as a group. Due to the drought conditions and the hail storm, a very small percentage of lambs was saved in 1951. Because of the small size of many of the lambs, it was believed these lambs would never develop satisfactorily for breeding flock replacements.

The yearling rams and ewes were scored for face covering, color and outercoat just prior to shearing in April. Body weights, type and condition scores were taken the latter part of May. These weights and scores were taken in a manner similar to that described for the weanling lambs.

The fleeces of yearling ewes and rams and mature breeding rams were sampled in advance of shearing for evaluation of staple length, grade, percentages of kemp and other medullated fibers and clean yield. Staple length was measured at mid-side, while average fiber diameter and frequency of kemp and other medullated fibers were measured and recorded for both side and thigh positions. A side sample taken from skin area two inches wide by about five inches in length was processed to obtain the yield of bone-dry clean wool.

At shearing time, each fleece was weighed and the weight recorded to the nearest 0.05 pound. Grease fleece weights of yearling ewes and rams were adjusted to exactly 365 days of growth. Estimated clean fleece weights were calculated by multiplying the grease fleece weight by the percentage yield of bone-dry clean wool in the side sample, and adjusting for 12 percent moisture content.

RESEARCH PROJECT 1

IMPROVEMENT OF NAVAJO SHEEP BY LINEBREEDING AND SELECTION IN THE NAVAJO STRAIN.

The objective of this project is to improve the Navajo strain of sheep for wool production and mutton conformation and to fix desirable characteristics. The Navajo sheep have greatest value as a source of inheritance for hardiness and adaptability to semi-arid ranges, high fertility and milk production. Improvement in the quality and uniformity of the Navajo sheep will increase their usefulness for crossbreeding with improved breeds.

Data on the characteristics and production of Navajo ewes and rams, and the traits of their weanling and yearling progeny are summarized in this section.

The data on weanling lambs has been adjusted to a constant age and for differences due to type of birth and rearing, and for age of dam.

CHARACTERISTICS OF NAVAJO BREEDING RAMS

Fleece characteristics of Navajo rams mated to Navajo ewes in the years 1947 through 1951 are summarized in the following table. The data were taken on all rams at yearling age. Rams have been selected consistently for well-improved fleeces grading 46s, 48s or 50s, free from kemp fibers.

Year	No. of rams	Age of rams at breeding (years)	Fleece weights as yearlings		Yearling Fiber Traits at Side		
			Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)	Medullated fibers (percent)
1947	3	2.0	6.98	4.93	50s	17.2	1.1
1948	4	2.0	7.56	5.02	48s	18.4	.0
1949	4	3.0	7.15	4.86	48s	17.8	.0
1950	4	1.7	6.93	4.39	48s	13.9	1.8
1951	5	1.8	7.01	4.11	50s	13.1	.0
Total & Averages	20	2.1	7.13	4.62	48s	15.9	.6

CHARACTERISTICS OF NAVAJO BREEDING EWES

The following table summarizes the characteristics of the Navajo ewes bred to Navajo rams in the years 1947 through 1951.

Year	No. of Ewes	Age of Ewes at Breeding (yrs.)	Body wt. at 18 months (lbs.)	Fleece weights as yearlings		Grade	Yearling Fiber Traits at Side		
				Grease	Clean		Staple Length (cms.)	Kemp (per- cent)	Other med. fibers (percen
				(lbs.)	(lbs.)				
1947	114	5.7	96.7	4.60	3.18	58s	9.5	0.9	1.7
1948	120	7.4	99.4	5.34	3.68	58s	9.0	0.6	0.6
1949	132	5.0	101.1	5.51	3.64	58s	10.0	0.3	0.8
1950	140	5.1	102.8	5.68	3.69	58s	10.2	0.2	1.2
1951	156	4.9	98.2	5.15	3.08	56s	11.1	0.0	1.5
Total & Aver- ages	662	5.6	99.7	5.27	3.45	58s	10.0	0.4	1.2

Comparison of the data by years reveals a gradual increase in average body weights, fleece weights and staple length, with a decrease in the quantity of kemp. The reversal of this trend in 1951 can be attributed to the severe drought conditions of 1950 and 1951. Selection of Navajo ewes has been restricted, however, in order to permit some increase in numbers.

LAMB PRODUCTION OF NAVAJO MATINGS

Year	No. of ewes bred	Percent of ewes lambling	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born.	Average weaning wt. in pounds	Pounds of lamb per ewe bred
1937-41	1745	88.3	105.1	97.3	92.5	57.0	55.4
1942-46	852	88.6	130.0	109.7	84.4	58.1	63.8
1947	118	83.9	125.4	117.8	92.0	60.5	71.9
1948	123	78.9	128.5	103.3	80.4	57.3	64.4
1949	133	85.0	116.5	93.2	80.0	56.4	52.6
1950	140	61.4	78.3	68.1	87.0	42.4	28.9
1951	156	88.5	95.5	31.4	32.9	32.6	10.2
1947-51	670	79.6	107.4	79.8	72.7	48.8	43.3

The 1951 lamb production of Navajo ewes mated to Navajo rams is summarized in the above table. For purposes of comparison, the first and second 5 year averages are included along with the combined averages for the last 5 years.

The average weaning weights shown for the first two 5 year periods constitute unadjusted individual weights of the lambs at an age of about 140 days.

The very low figures for percent of lambs weaned, average weaning weight, and pounds of lamb per ewe were due primarily to the huge death losses that occurred during the hail storm of May 29, 1951 as previously described. Losses within this project amounted to 34.0 percent of the ewes and 53.7 percent of the lambs born alive.

Average weaning weight of 32.6 pounds, the lowest on record, can be attributed to both the injury and setback caused by the storm, and the severe drought which continued through 1951. Growth of the lambs was very sharply retarded by the unfavorable nutritional and other environmental conditions with the result that the weight in 1951 was 25 pounds below the 10 year average, 1937-1946.

FACE AND BODY SCORES OF NAVAJO WEANLING LAMBS

Year	RAM LAMBS				EWE LAMBS			
	No. of lambs	Face covering (score)	Type (score)	Condition (score)	No. of lambs	Face covering (score)	Type (score)	Condition (score)
1947	56	2.71	3.50	3.61	80	2.72	3.19	3.15
1948	73	2.83	3.10	2.88	59	2.76	3.04	2.73
1949	66	2.64	3.09	3.00	58	2.65	3.22	2.92
1950	54	2.44	3.36	4.38	40	2.33	3.23	4.02
1951	21	2.43	3.49	3.53	28	2.52	3.49	3.34
Total & Averages	270	2.65	3.26	3.41	265	2.63	3.20	3.16

In the above table, face and body scores have been summarized by sex and years.

In the past five years the Navajo lambs have shown steady improvement with respect to face covering. Navajo lambs of both sexes had less face covering than crossbred lambs.

Condition scores for 1951, while still below the five year average, showed a marked improvement over 1950. This may be due to improved forage conditions resulting from July and August rains. The rains, though below average in quantity, marked the first major break in the two-year drought.

Type scores were slightly lower in 1951 than in 1950, and reflect the low plane of nutrition that slowed growth and development the first two months of life. It is probable that the low condition scores and low weights influenced the type scores to some extent. Ram lambs and ewe lambs were about equally affected by the drought.

FLEECE CHARACTERISTICS OF NAVAJO WEANLING LAMBS

Data on fleece characteristics of Navajo weanling lambs for the years 1947 through 1951 are summarized in the next table. In 1947, staple length was measured at a constant age of 111 days; in each of the years 1948, 1949 and 1950 it was measured at 84 days of growth; and in 1951, it was adjusted to a constant age of 120 days. These differences should be considered in comparing the means of the four years.

The percentages of kemp and other medullated fibers have been maintained at low levels but without any appreciable change during the past five years. Complete elimination of these objectionable fibers by selection within the Navajo strain will undoubtedly be difficult to achieve.

Twelve Navajo ewe lambs were saved in 1951, a decrease of 54 percent from the 26 saved in 1950. Selection was greatly limited by the small numbers and small size of the surviving lambs. The number of ram lambs saved was smaller than previous years. However, only a small number of Navajo ram lambs are retained each year, and the number saved was deemed adequate for replacement needs.

The relative emphasis among the various traits for the ram lambs was greatest for condition score, followed by type score, color and weaning weight. The relatively low emphasis placed on weaning weight can be explained by the fact that a minimum weight of 40 pounds was established for ram lambs. All ram lambs exceeding this weight were considered eligible with selection being based on other factors. In the ewe lambs most emphasis was placed on fiber diameter, followed by weaning weight and outercoat score. A minimum weight of 30 pounds was established for the ewe lambs.

The outercoat scores for the Navajo lambs indicate that the amount of coarse hair fiber is being gradually reduced through selection of breeding rams.

Year	No. of lambs	Grade	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)	Outercoat (score)	a/
1947	137	56s	4.7	0.0	0.4	-	
1948	125	56s	3.4	.3	3.2	3.78	
1949	124	50s	4.1	.2	2.1	3.18	
1950	94	56s	3.3	.3	4.3	3.36	
1951	49	60s	4.2	.0	3.5	3.27	
Total & Averages	529	56s	4.0	.2	2.4	3.43	

a/ Scores for outercoat not taken prior to 1948.

SELECTION PRACTICED ON NAVAJO LAMBS

The percentages of Navajo lambs saved, by sexes, the selection differentials for all traits considered at weaning age, the relative emphasis placed on each trait at culling time, and the expected genetic gains are given in the following table.

The estimates of genetic gains in the following tables for each research line project are an indication of how much the selected lambs are superior in actual breeding value to the unselected groups from which they were chosen. The heritability values used in the calculation of the estimates of genetic gains are those obtained for range Rambouillet lambs at Dubois, Idaho. Thus these estimates are valid only to the extent that these heritability estimates are applicable to the lambs at this station.

SELECTION DIFFERENTIALS, RELATIVE EMPHASIS, AND EXPECTED GENETIC GAIN FOR NAVAJO WEANLING LAMBS

Sex	Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
Rams	Advantage of								
	selected lambs	4.34	-.29	1.00	.04	.38	.50	.62	.20
	Relative emphasis	.54	-.34	.38	.10	.70	.72	.67	.34
	Expected genetic gain	1.30	-.12		.02	.05	.20		14.29
Ewes	Advantage of								
	selected lambs	1.93	.11	1.25	.10	-.04	.09	.08	.18
	Relative emphasis	.40	.18	.52	.21	-.11	.15	.08	.36
	Expected genetic gain	.58	.04		.06	-.01	.04		42.86

BODY WEIGHTS AND SCORES OF NAVAJO YEARLING RAMS

Year	No. of rams	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer- coat (score)
1947	2	115.0	2.25	3.17	3.09	1.50	-
1948	6	115.2	2.23	3.20	2.96	1.17	-
1949	14	112.3	2.33	2.89	2.64	1.36	2.24
1950	10	103.5	2.60	3.00	2.97	1.50	2.07
1951	9	90.9	2.58	2.67	3.13	1.00	3.60
Total & Averages	41	106.0	2.43	2.93	2.90	1.29	2.56

Body weights of the rams do not show as sharp a drop as the weights of the ewes. Apparently the wheat pasture on which the rams were maintained proved superior to the drylot feeding of the ewes. However, the crippling effects of the severe drought are indicated by the fact that in spite of good feed, neither group was able to reach the 1947 - 1949 average.

It may be noted that the face, color and body scores have remained essentially the same during the past 5 years. The number of lambs available to select from, of straight Navajo breeding, is small. A large number of Navajo ewes in recent years have been allotted to purebred rams in the crossbreeding program.

FLEECE CHARACTERISTICS OF NAVAJO YEARLING RAMS

Data on various fleece characteristics of Navajo yearling rams for the years 1947-1951 are summarized below. The fleeces of all rams were free from kemp fibers. Selection against coarse outercoat and kemp fibers has greatly improved fleece quality and uniformity, but at the same time it has reduced the effectiveness of selection for fleece weight and staple length. Average values for fleece weight and grade in 1951 are considerably lower than in prior years.

Year	No. of rams	Fleece weights		Grade	Fiber Traits at Side	
		Grease (lbs.)	Clean (lbs.)		Staple length (cms.)	Medullated fibers (percent)
1947	2	7.18	4.70	46s	14.8	0.0
1948	6	6.65	3.88	48s	15.0	1.2
1949	14	6.43	4.30	56s	11.6	.1
1950	10	6.56	3.92	56s	12.6	.0
1951	9	5.82	3.32	50s	12.8	2.1
Total & Averages	41	6.40	3.95	56s	12.8	.7

BODY WEIGHTS AND SCORES OF NAVAJO YEARLING EWES

Year	No. of ewes	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat a/ (score)
1947	39	84.6	2.07	3.29	3.13	2.46	-
1948	75	86.8	2.58	2.97	2.68	1.32	-
1949	55	77.9	2.31	2.74	2.49	1.72	3.08
1950	46	75.7	2.43	2.84	2.91	1.30	3.05
1951	26	46.6	2.51	3.35	3.20	1.88	3.38
Total & Averages	241	78.0	2.40	2.99	2.81	1.65	3.13

a/ Outercoat scores not taken prior to 1949.

Yearling ewes in 1951 declined in all traits, with body weight showing the greatest drop. The 1950 lambs were so severely stunted by drought and poor feed conditions that even when placed in feed lot during the winter of 1950-1951 they were unable to recover to a normal weight. These ewes will probably always be small in size and will be culled from the flock as soon as suitable replacements become available.

FLEECE CHARACTERISTICS OF NAVAJO YEARLING EWES

Year	No. of ewes	Fleece weights		Grade	Fiber Traits at Side		
		Grease (lbs.)	Clean (lbs.)		Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)
1947	39	5.14	4.00	48s	11.4	0.1	3.0
1948	75	6.19	3.82	56s	12.5	.2	1.1
1949	55	5.73	3.69	58s	10.5	.5	3.0
1950	46	6.38	3.38	58s	11.4	.1	1.6
1951	26	3.27	1.75	64s	10.2	.1	.9
Total & Averages	241	5.64	3.51	56s	11.4	.2	1.9

Grease fleece weights of yearling Navajo ewes were considerably lower in 1951 than in previous years. However, the fleeces contained less dirt and therefore showed a higher percent yield of clean wool than in 1950. Since 1949 the fleeces have averaged finer in fiber diameter, which has been influenced, no doubt, by the lowered plane of nutrition. Staple length on the other hand has remained practically constant during these years. In general, the low fleece weights for 1951 were due to the small body size of the ewes, which in turn was caused by the unfavorable environment. Range conditions during the winter of 1950-1951 were particularly unfavorable for the growth and development of ewe lambs.

RESEARCH PROJECT 2

IMPROVEMENT OF NAVAJO SHEEP BY CROSSBREEDING AND SELECTION FOR THE PRODUCTION OF WOOL SUITABLE FOR BOTH HAND AND COMMERCIAL METHODS OF MANUFACTURE

The objective of this research project is the development of coarse-wooled strains of sheep that combine adaptability to southwestern ranges with efficient production of good quality feeder lambs and wool of 46s, 48s and 50s grades. Selection emphasis is placed primarily on adaptability and longevity of the sheep, yield of wool and its suitability with respect to hand weaving and commercial manufacture, and the quantity and quality of lambs produced.

Information on the characteristics and production of the sheep used in project 2 are presented in this section.

CHARACTERISTICS OF COARSE WOOL, CROSSBRED BREEDING RAMS

Various characteristics of the breeding rams used in project 2 are presented in the following table. Since breeding groups 2, 3, 6 and 7 were eliminated in 1951, the 1950 totals shown at the bottom of the table include only those rams used in breeding groups 8, 9, 10, 11 and 16. Breeding rams have been selected with major emphasis on fleece quality. Fleece characteristics considered are grade, staple length, uniformity, freedom from kemp and other medullated fibers, and yield of clean wool.

Crossbred rams with inheritance of 1/2 Navajo were used in groups 9 and 10, with 3/8 Navajo in group 11, and with 1/4 Navajo in groups 8 and 16.

The only significant difference between the years 1950 and 1951 appears in the yield of clean wool. Grease fleece weights are practically identical. This indicates that while the mature rams were naturally better able to withstand the adverse environment than the yearlings, the severe drought of 1950-1951 did materially reduce the production of wool and cause the deposition of greater amounts of dirt and other foreign matter in the fleeces.

Breeding Group No.	No. of rams	Age of ram at breeding time (years)	Body weight at breeding time (lbs.)	Yearling fleece weights		Yearling Fiber Traits at Side		
				Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)	Med. fibers (percent)
8	5	2.1	180.8	11.19	6.18	48s	13.62	.25
9	4	2.1	185.3	9.59	4.98	56s	11.73	.0
10	4	1.8	176.0	9.51	5.47	50s	12.05	.0
11	3	2.6	197.3	11.10	6.66	50s	13.00	.0
16	2	1.6	162.5	10.00	5.77	46s	13.90	.0
Total & Averages								
1951	18	2.1	181.4	10.31	5.79	50s	12.77	.06
1950	15	1.4	178.9	10.48	6.97	48s	12.67	.04

CHARACTERISTICS OF COARSE WOOL, CROSSBRED BREEDING EWES

Body weights at 18 months and yearling fleece weights and fiber characteristics of the breeding ewes in project 2 are summarized below by their respective groups. When making comparisons of group averages it should be remembered that the ewes in groups 8 and 11 have inheritance of 1/2 Navajo, those in group 16, 3/8 Navajo and those in groups 9 and 10, 1/4 Navajo. In general, full blood Navajo ewes reach mature body weight at about 2 years of age. The crossbred ewes tend to mature at 2.5 to 3 years of age and reach maximum production at 3 to 4 years of age.

The Columbia x Navajo ewes of group 8 repeatedly have the highest average body and fleece weights. Crossbred ewes sired by Cotswold and Lincoln rams, groups 9 and 10, were similar as regards body and fleece weights, and both groups ranked close to the Columbia x Navajo. Ewes of group 16, having inheritance from both the Columbia and Cotswold breeds, also had a high yield of clean wool.

Fleece grades at the side are, as previously stated, based on the average fiber diameter at the base end of the staple, and thus are influenced by the health and plane of nutrition of the sheep during the late winter and early spring months.

Breeding Group No.	No. of ewes	Average age at breeding (years)	Average 18 mos. wt. (lbs.)	Yearling fleece weights		Fiber Traits at Side			
				Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)	Per-cent kemp	Per-cent other med. fibers
8	164	3.1	113.9	7.99	4.49	58s	10.6	.01	1.31
9	122	3.3	110.9	7.63	4.39	56s	13.1	.04	1.97
10	148	2.7	110.7	7.49	4.40	58s	11.5	.0	1.28
11	116	2.5	103.3	7.04	3.87	58s	9.8	.0	.75
16	62	1.9	102.9	7.62	4.15	60s	12.0	.02	1.17
Total & Averages									
1951	612	2.8	109.4	7.58	4.29	58s	11.3	.01	1.27
*1950	501	2.7	114.9	7.43	4.51	56s	11.1	.00	1.74

* Since breeding groups 2, 3, 6 and 7 were discontinued in 1951, the totals for 1950 include only those ewes assigned to breeding groups 8, 9, 10, 11 and 16.

LAMB PRODUCTION OF COARSE WOOL, CROSSBRED MATINGS

By Breeding Groups for 1951

Group No.	No. of ewes bred	Percent of ewes lanbing	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs born	Average weaning weight in pounds	Pounds of lamb per ewe bred
8	164	82.32	84.15	42.68	50.72	38.54	16.45
9	122	95.90	97.54	40.16	41.18	33.68	13.53
10	148	90.54	91.89	46.62	50.74	33.90	15.80
11	116	82.76	84.48	36.21	42.86	37.54	13.59
16	62	91.94	91.94	32.26	35.09	34.25	11.05
Total & Averages							
1951	612	88.07	89.54	40.85	45.62	35.80	14.62

By 5-Year Periods

1937-41	1216	88.3	109.4	97.1	88.8	59.9	58.2
1942-46	1794	79.8	110.0	89.4	81.3	59.4	53.1
1947-51	3882	79.0	100.5	76.6	76.2	57.9	44.3

Lamb production of Navajo crossbred ewes mated to crossbred rams of medium and coarse wool breeding are presented in the preceding table. Averages for prior years in 5-year groups are also shown.

The percentage of ewes lanbing in 1951 exceeds the latest 5-year average in all groups. Groups 9, 10 and 16 exceed the all-time averages in this respect.

As described earlier, the hailstorm of May 29, 1951 was primarily responsible for the very low percentage of lambs weaned. This freak storm which lasted less than 30 minutes killed 11.11 percent of the ewes bred and 42.88 percent of the lambs born alive in this project. The low weaning weights can be attributed to the combined effects of the storm on the survivors and the poor range conditions prevalent throughout the rest of the summer.

FACE AND BODY SCORES OF COARSE WOOL, CROSSBRED WEANLING LAMBS

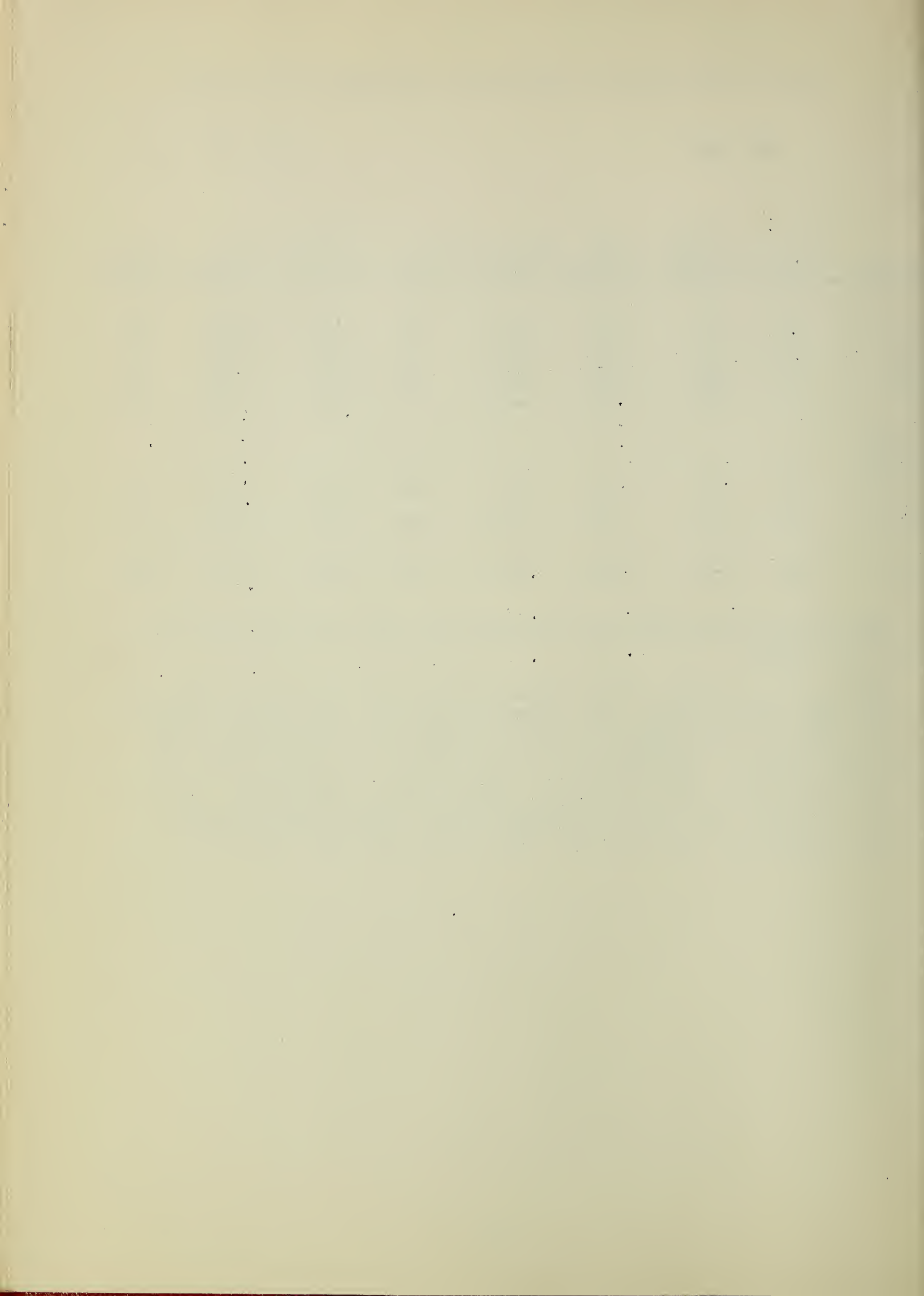
RAM LAMBS

EWE LAMBS

Group No.	No. of lambs	Face covering (score)	Type (score)	Condition (score)	No. of lambs	Face covering (score)	Type (score)	Condition (score)
8	37	2.92	3.02	3.21	33	2.72	2.98	3.03
9	30	2.53	3.35	3.46	19	2.69	3.38	3.47
10	36	2.59	3.17	3.25	33	2.48	3.35	3.37
11	17	2.63	2.93	2.97	25	2.70	3.05	3.14
16	13	2.85	3.19	3.37	7	2.45	3.27	3.54
Total & Averages								
1951	133	2.70	3.14	3.26	117	2.63	3.18	3.25
1950	358	2.99	2.94	3.97	362	2.85	2.88	3.85
1949	311	3.04	2.45	2.51	318	2.98	2.57	2.49

Face and body scores have been summarized for sex, groups and years in the preceding table.

Averages for the three scores indicated were essentially the same for both ewe lambs and ram lambs. Face covering scores have been steadily improving since 1949. Wool blindness is seldom a problem in sheep containing some Navajo inheritance. Condition scores, while still not up to par, show some improvement over 1950. This is probably a reflection of the July and August rains and the improved forage conditions shortly before weaning time. Type scores are somewhat lower than in preceding years. Group 8 lambs continue to show slightly better type than the other groups, while group 11 lambs carry more condition.



FLEECE CHARACTERISTICS OF COARSE WOOL, CROSSBRED WEANLING LAMBS

Group No.	No. of lambs	Grade	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)	Outer-coat (score)
8	70	56s	4.4	.03	3.79	3.09
9	49	60s	4.1	.10	2.39	2.99
10	69	60s	4.1	.07	.84	2.95
11	42	60s	4.5	.00	1.19	2.82
16	20	60s	3.8	.37	3.22	2.84
Total & Averages						
1951	250	60s	4.2	.08	2.19	2.97
1950	720	56s	3.9	.1	3.76	2.97
1949	628	56s	4.3	.2	3.29	2.96

The preceding table summarizes the data on fiber characteristics of the weanling lambs. All breeding groups in this project were relatively uniform for all traits measured. Groups 9, 10, 11 and 16 had fleeces that were slightly finer in fiber diameter than the corresponding groups for 1950, while group 8 fleeces were slightly coarser. All groups showed an increase in staple length over 1950, with group 11 excelling the other groups in this respect. Kemp and medullation percentages were about the same as those for 1950, with the exception of group 10, which showed considerable improvement.

SELECTION PRACTICED ON COARSE WOOL, CROSSBRED WEANLING LAMBS

In research project 2, a total of 9 ram lambs and 35 ewe lambs were saved from weaning numbers of 133 and 117, respectively. The percentages of lambs saved were considerably less than in prior years, the heavy culling being due to the small size of lambs at weaning. As a result of this drastic culling, higher selection differentials were obtained for most of the traits than were obtained in previous years.

The principle selection emphasis was placed on weaning weight, with the establishment of a 40 pound minimum. This resulted in a strong selection pressure for weight, and with the exception of staple length and face covering score, all selections were positive. It might seem interesting that heavier weights would be associated with a negative selection differential for face covering score in groups 9 and 10. These values are very small, however, and are not statistically significant. Selection against kemp and coarse outercoat fibers naturally results in a negative selective pressure against staple length.

SELECTION PRACTICES ON COARSE WOOL, CROSSED WEANING LAMBS

Group No.	Sex	Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Per-cent saved
8	Rams	Advantage of selected lambs	-	-	-	-	-	-	-	0
		Relative emphasis								
		Expected genetic gain								
	Ewes	Advantage of selected lambs	5.72	-.39	.75	.11	.11	.23	.45	-.03
		Relative emphasis	.94	-.61	.27	.33	.27	.42	.45	-.07
		Expected genetic gain	1.72	-.16	-	.06	.01	.09	-	-
										24.24
9	Rams	Advantage of selected lambs	10.08	-.14	1.42	.11	.58	.78	.43	.32
		Relative emphasis	1.23	-.14	.42	.31	.92	1.18	.50	.65
		Expected genetic gain	3.02	-.06	-	.06	.08	.31	-	-
										6.67
	Ewes	Advantage of selected lambs	4.40	-.35	1.28	-.03	.46	.65	-.08	.34
		Relative emphasis	.58	-.38	.48	-.08	.71	.78	-.13	.60
		Expected genetic gain	1.32	-.14	-	-.02	.06	.26	-	-
										36.84
10	Rams	Advantage of selected lambs	4.99	-.01	1.15	-.06	.57	.62	.19	.13
		Relative emphasis	.91	-.02	.48	-.14	1.00	1.05	.21	.34
		Expected genetic gain	1.50	-.004	-	-.03	.07	.25	-	-
										13.89
	Ewes	Advantage of selected lambs	3.80	.02	1.05	-.12	.56	.64	.30	.15
		Relative emphasis	.55	.03	.36	-.35	.86	.80	.33	.36
		Expected genetic gain	1.14	.01	-	-.07	.07	.32	-	-
										27.27

SELECTION PRACTICED ON COARSE WOOL, CROSSED WEANLING LAMBS, CONT.

Group No.	Sex		Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Per-cent saved
11	Rams	Advantage of selected lambs	2.85	-.06	3.93	.38	.09	.18	-.24	-.29	11.76
		Relative emphasis	.55	-.09	1.35	.81	.19	.33	-.27	-.52	
		Expected genetic gain	.86	-.02	-	.21	.01	.07	-	-	
	Ewes	Advantage of selected lambs	4.50	-.01	.97	.12	.32	.22	-.25	.18	33.33
		Relative emphasis	.83	-.01	.33	.33	.80	.49	-.35	.35	
Expected genetic gain		1.35	-.004	-	.07	.04	.09	-	-		
16	Rams	Advantage of selected lambs	-	-	-	-	-	-	-	-	0
		Relative emphasis									
		Expected genetic gain									
	Ewes	Advantage of selected lambs	7.32	-.83	.53	.34	.32	.59	-.38	.51	42.86
		Relative emphasis	.84	-.70	.16	.69	.59	.69	-.50	.80	
Expected genetic gain		2.20	-.33	-	.19	.04	.24	-	-		

BODY WEIGHTS AND SCORES OF COARSE WOOL, CROSSBRED YEARLING RAMS

Average body weights and face covering and condition scores declined for the second consecutive year, a fact which must be attributed to the adverse environmental conditions of 1950 and 1951. Note that the largest group (group 3) excelled in most traits, while the smallest (group 16) had the lowest averages for several traits.

Group 3 rams had the heaviest yearling body weight and were 7.7 pounds above the overall average; while group 16 rams were 6.7 pounds below the average. All other groups ranged near the mean of 109.7 pounds.

Face scores were slightly lower than previous years, with group 3 excelling and group 7 the worst in this respect. Type and color scores remained essentially the same as those of 1949 and 1950. Condition and outercoat scores are relatively uniform and show a slight but regular decline throughout all groups of this project.

Group No.	No. of rams	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)
2	10	110.0	2.84	2.17	2.67	1.20	2.60
3	13	117.4	2.60	2.18	2.28	1.62	2.26
6	8	108.0	3.00	2.54	3.13	1.25	3.31
7	4	105.0	3.30	2.42	3.08	1.75	3.38
8	8	110.8	3.25	2.42	2.56	1.25	2.92
9	9	105.3	3.09	2.48	2.76	1.44	3.02
10	5	110.0	3.04	2.40	2.77	1.00	2.54
11	7	105.8	3.07	2.19	2.69	1.14	2.97
16	2	103.0	2.76	2.67	3.08	2.00	2.92
Totals & Averages							
1951	66	109.7	2.96	2.32	2.70	1.36	2.81
1950	102	118.0	2.75	2.39	2.57	1.37	2.40
1949	98	126.0	2.63	2.21	2.20	1.38	2.56

FLEECE CHARACTERISTICS OF COARSE WOOL, CROSSBRED YEARLING RAMS

Grease fleece and clean fleece weights averaged considerably lower than either the 1950 or 1949 fleece weights. This was due largely to the drought with the resultant lowered plane of nutrition. In addition, the 1951 fleeces contained larger amounts of dirt and other foreign material, which caused an appreciable reduction in the percent yield of clean wool.

Group 3, which excels in weight of both grease fleeces and clean fleeces, has the shortest staple and finest grade fiber; group 16, which is light in fleece weights, has an average fiber grade and the second longest staple; while group 7, which has an average grease fleece weight and a coarser fiber grade, excels in weight of clean fleece and staple length.

Average fleece grade was the same as for previous years.. With the exception of group 3, all groups graded 48s or 50s, which are the preferred grades for this project. All yearling ram fleeces were free from kemp, while the percent of other medullated fibers was essentially the same as for 1950.

Group No.	No. of rams	Fleece weights		Fiber Traits at Side		
		Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)	Other med. fibers (percent)
2	10	8.10	4.03	50s	13.5	0
3	13	9.80	4.14	56s	9.8	0
6	8	8.80	3.93	48s	12.7	1.36
7	4	8.80	4.14	48s	14.1	1.33
8	8	9.39	4.06	50s	10.4	0
9	9	8.23	3.51	50s	11.6	.20
10	5	7.18	3.59	48s	11.1	0
11	7	8.33	4.13	50s	12.7	.30
16	2	7.29	3.29	50s	13.9	0
Totals & Averages						
1951	66	8.67	3.93	50s	11.8	.29
1950	102	9.28	5.61	50s	13.4	.20
1949	101	9.40	6.46	50s	12.4	.60

BODY WEIGHTS AND SCORES OF COARSE WOOL, CROSSBRED YEARLING EWES

The 1951 yearling ewes suffered a greater reduction in body weight from prior years than did the yearling rams in the same breeding groups. This was due largely to the fact that the rams were given supplemental feed while the ewes were maintained on droughty ranges.

Body weights and scores were remarkably uniform throughout all groups, there being a difference of only 4.1 pounds between the heaviest and lightest groups. However, the overall average weight of 53.5 pounds was 36.5 percent below the 1949-1950 average. Face, type, condition, and outercoat scores were equally uniform, but only slightly below previous years, while color scores remained essentially the same.

Group No.	No. of ewes	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)
2	12	55.8	2.72	2.46	2.85	1.33	2.47
3	29	52.8	2.73	2.63	2.81	1.28	2.53
6	17	55.9	3.12	2.64	3.03	1.65	3.08
7	22	52.0	2.97	2.72	3.07	1.38	3.44
8	32	53.8	2.97	2.69	2.88	1.47	2.79
9	25	54.7	2.89	2.76	3.03	1.56	2.91
10	22	52.3	2.97	2.80	3.08	1.45	2.92
11	24	51.7	2.97	2.78	2.93	1.12	3.04
16	6	55.5	2.50	2.61	2.56	1.50	2.84
Totals & Averages							
1951	189	53.5	2.90	2.70	2.94	1.40	2.89
1950	219	83.1	2.80	2.36	2.59	1.41	2.78
1949	260	85.4	2.34	2.22	2.27	1.38	2.74

FLEECE CHARACTERISTICS OF COARSE WOOL, CROSSBRED YEARLING EWES

Data on various fleece characteristics of the coarsewooled, crossbred yearling ewes are summarized in the next table.

Grease fleece and clean fleece weights were relatively uniform throughout the nine breeding groups, but were considerably lighter than in preceding years. Mean grease fleece weights were 2.90 pounds below the 1949-1950 average, while clean fleece weights were 2.03 pounds lighter. Short feed and dry range conditions contributed to higher shrinkage and decreased yields of clean wool. The fleece grades of all groups were finer than would be expected under more normal range and feed conditions.

Group No.	No. of ewes	Fleece weights		Grade	Fiber Traits at Side		
		Grease (lbs.)	Clean (lbs.)		Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)
2	12	5.00	2.47	64s	11.64	0	0
3	29	4.97	2.47	70s	10.78	.02	.92
6	17	5.09	2.64	64s	11.55	0	.05
7	22	4.57	2.53	64s	11.96	0	.15
8	32	4.60	2.21	70s	11.43	0	0
9	25	4.45	2.19	70s	10.76	0	.42
10	22	4.11	2.00	70s	11.29	0	.05
11	24	4.63	2.24	70s	10.60	0	.23
16	6	4.50	2.24	70s	11.12	0	0
Totals & Averages							
1951	189	4.65	2.32	70s	11.2	.0	.3
1950	219	8.14	4.09	60s	12.0	.0	.4
1949	260	7.06	4.66	60s	10.8	.1	.9

RESEARCH PROJECT 3

IMPROVEMENT OF NAVAJO SHEEP BY CROSSBREEDING AND SELECTION FOR RANGE PRODUCTION OF WOOL AND LAMBS SUITED TO MARKET REQUIREMENTS

The objective of this project is to develop a strain of sheep that will be well adapted to southwestern range conditions, with inheritance for efficient production of high quality feeder lambs and combing length wool of 60s and 62s grades. This project was initiated in 1948. Crossbred ewes with inheritance of 1/2 Navajo, 1/4 Romney and 1/4 Corriedale were mated with carefully selected rams of the Targhee, New Zealand Merino and Debouillet breeds, and Navajo ewes were mated to a Rambouillet ram to test the relative performance of these crosses under the same environmental conditions.

The characteristics of the breeding ewes and rams and their weanling and yearling progeny are summarized in this section.

CHARACTERISTICS OF FINE WOOL BREEDING RAMS

Group No.	No. of rams	Age of ram at breeding (years)	Average body wt. at breeding time (lbs.)	Fleece weights as Yearlings		Fiber Traits at Side	
				Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)
12	6	2.7	210.5	12.17 <u>a/</u>	5.07 <u>a/</u>	64s	9.92
13	1	1.6	154.0	10.80	5.00	62s	10.30
15	5	2.8	198.4	10.04	5.20 <u>b/</u>	64s	7.06
Totals & Averages							
1951	12	2.6	194.9	10.83	5.10	64s	8.76
1950	5	3.0	189.8	12.69	6.92	64s	12.20
1949	4	2.0	-	13.02	6.84	64s	12.23

a/ Three of the rams in group 12 were purchased from private breeders. Yearling fleece weights were not available.

/ Three of the rams in group 15 were purchased from private breeders. Yearling clean fleece weights were not available

Targhee rams were used in breeding group 12, F₁ Rambouillet x Navajo rams in group 13, and Rambouillet rams in group 15.

CHARACTERISTICS OF NAVAJO AND CROSSBRED BREEDING EWES

The 237 ewes in breeding groups 12 and 13 were selected from that portion of the breeding flock having an inheritance of 1/2 Navajo, 1/4 Romney and 1/4 Corriedale, with fleeces grading 1/2 blood or finer. In general, these ewes had large frames, open faces and were free from wool on the lower legs. The wool was long staple, but lacked density, hence grease and clean fleece weights were comparatively low.

The breeding ewes in group 15 were mated to Rambouillet rams. The ewes were selected at random from the Navajo flock. Their fleeces averaged slightly coarser, longer staple, and contained more kemp and other medullated fibers than those of the crossbred ewes in groups 12 and 13.

Group No.	No. of ewes	Age of ewes at breeding (years)	Body weight at 18 mos. (lbs.)	Fleece weights as Yearlings		Fiber Traits at Side			
				Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)	Kemp (per-cent)	Other
									Med. Fiber (per-cent)
12	205	5.0	106.1	6.90	3.09	50s	12.4	.1	2.9
13	32	1.6	97.2	8.08	2.96	70s	8.3	0	0
15	154	4.5	97.3	5.08	2.77	56s	11.0	.1	1.7
Totals & Averages									
1951	391	4.5	101.9	6.29	2.94	56s	11.2	.1	2.0
1950	156	5.8	107.5	5.48	3.07	60s	8.4	.1	.6
1949	126	5.2	108.8	5.76	3.22	60s	8.2	.1	.5

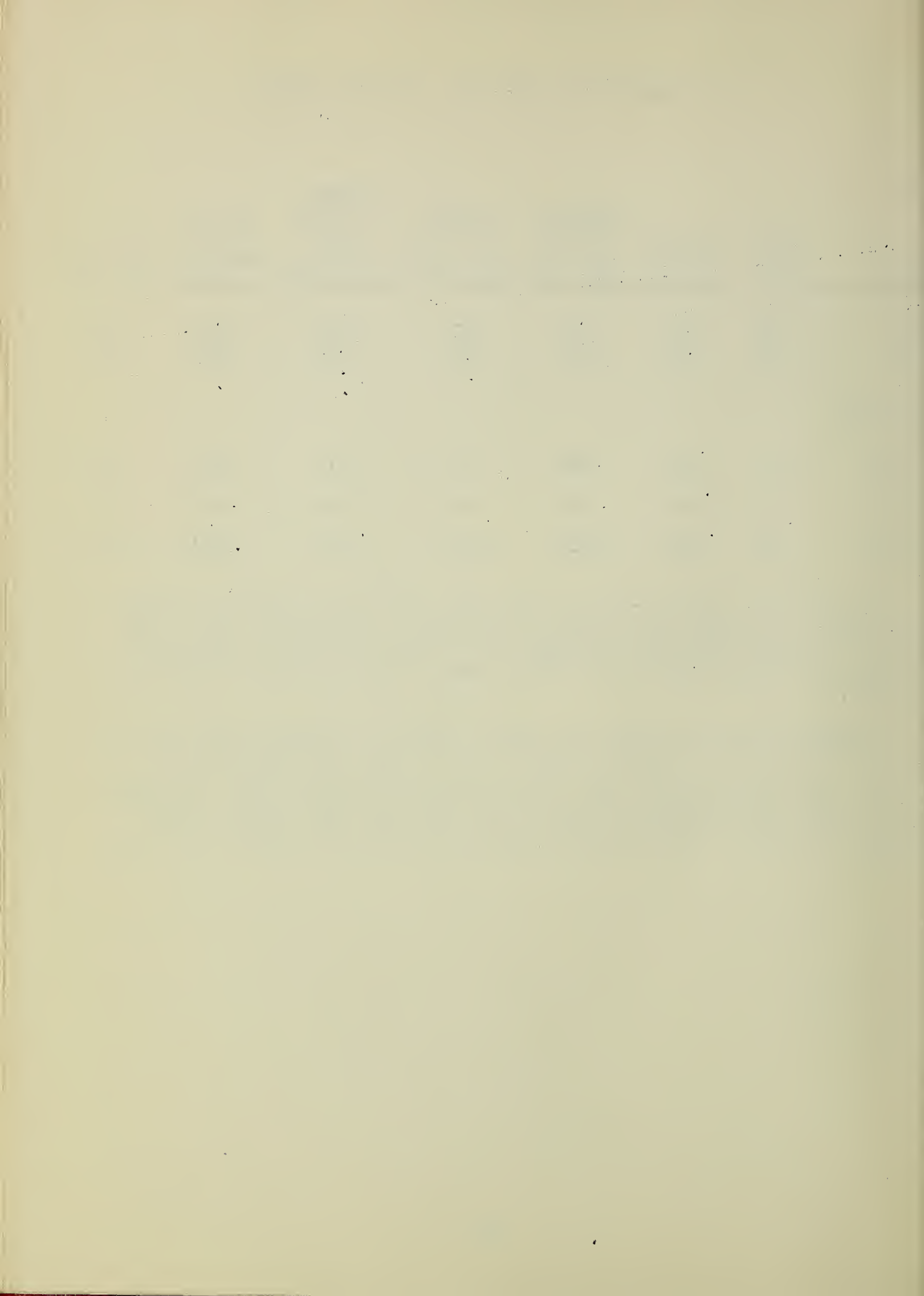


LAMB PRODUCTION OF FINE WOOL, CROSSBRED MATINGS

Group No.	No. of ewes bred	Percent of ewes lambing	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning weight in pounds	Pounds of lamb per ewe bred
12	205	83.9	90.7	34.1	37.6	36.2	12.4
13	32	93.8	87.5	21.9	25.0	34.7	7.6
15	153	92.2	96.1	31.4	32.7	35.2	11.1
Totals & Averages							
1951	390	87.9	92.6	32.1	34.6	35.8	11.5
1950	156	60.3	85.8	63.9	74.4	45.3	29.0
1949	128	89.9	131.3	107.3	81.5	62.1	66.5

In the above summary, group 12 represents the lamb production of Targhee rams mated to crossbred ewes; group 13 represents a Rambouillet x Navajo ram mated to Targhee, Debouillet, or Merino cross ewes; and group 15 represents the matings of Rambouillet rams to Navajo ewes. These matings were initiated in 1949.

Lambing percentages, while not equal to 1949, show considerable improvement over 1950 and can be considered satisfactory. Weaning percentages are, of course, very low due to the hail storm of May 29, 1951 which killed 26 percent of the ewes and 53 percent of the lambs born alive in this project. Low weaning weights can be attributed partly to the shock and after effects of the storm, and partly to the dry range conditions prevalent throughout most of the summer.



FACE AND BODY SCORES OF FINE WOOL, CROSSBRED WEANLING LAMBS

RAM LAMBS

EW E LAMBS

Group No.	No. of lambs	Face covering (score)	Type (score)	Condition (score)	No. of lambs	Face covering (score)	Type (score)	Condition (score)
12	36	2.96	3.22	3.36	34	2.59	3.17	3.20
13	3	2.56	2.90	2.78	4	2.59	3.40	3.41
15	22	2.84	3.35	3.44	26	2.79	3.36	3.16
Totals & Averages								
1951	61	2.90	3.25	3.36	64	2.67	3.26	3.20
1950	47	3.07	3.70	2.94	52	2.91	2.91	3.58
1949	74	3.10	2.52	2.49	63	3.04	2.57	2.39

In the preceding table face and body scores have been summarized by groups, year and sex for research project 3. Some improvement in face covering was evident in 1951, with the ewe lambs showing the greatest improvement. Ram lambs showed a slight improvement in type and a slight decrease in condition from 1950, while the ewe lambs reflected opposite trends for these two traits. Differences between groups within sexes were slight for all traits.

FLEECE CHARACTERISTICS OF FINE WOOL, CROSSBRED WEANLING LAMBS

Data on fleece characteristics of 125 weanling lambs produced in breeding groups 12, 13 and 15 are summarized in the following table.

All three groups had average fleece grades of 64s, which was one to two grades finer than previous years.

The Targhee cross lambs, group 13, had fleeces that were practically free from kemp and contained less medullated and outercoat fibers than those of other groups.

Group No.	No. of lambs	Grade	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)	Outercoat (score)
12	70	64s	3.5	0.13	0.96	2.07
13	7	64s	3.8	.00	3.65	2.29
15	48	64s	3.5	.20	1.73	2.27

Totals &
Averages

1951	125	64s	3.5	.14	1.39	2.14
1950	99	62s	3.0	.1	.9	2.10
1949	137	60s	3.4	.1	.5	2.26

SELECTION PRACTICED ON FINE WOOL, CROSSBRED WEANLING LAMBS

In the following table, the selection differentials show that positive selection was practiced for most traits considered. Among the ram lambs the greatest emphasis was placed on weaning weight followed in general by type and staple length. Among the ewe lambs the greatest emphasis was placed on weaning weight followed by type, condition and outercoat scores. As with the other groups, a minimum weight of 40 pounds was established for lambs retained. In regard to average fiber diameter all lambs graded half blood or finer, with the group averages grading 62s and 64s. All lambs saved were within the desired range of fineness.

As in the other groups, fewer lambs were saved in 1951 than in previous years due to the small size of the lambs at weaning. It was believed that those lambs which were culled would not develop satisfactorily for breeding flock replacements.

SELECTION PRACTICED ON FINE WOOL, CROSSBRED WEANLING LAMBS

Group No.	Sex		Meaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Body type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
12	Rams	Advantage of selected lambs	7.07	.40	-.88	.37	.62	-.47	-.36	.33	5.56
		Relative emphasis	.91	.66	-.30	.71	.93	-.73	-.86	.70	
		Expected genetic gain	2.12	.16	-	.21	.08	-.19	-	-	
	Ewes	Advantage of selected lambs	4.24	.03	1.27	-.07	.29	.42	.15	.16	32.35
		Relative emphasis	.80	.05	.47	-.15	.50	.66	.20	.35	
		Expected genetic gain	1.27	.01	-	-.04	.04	.17	-	-	
13	Rams	Advantage of selected lambs	-	-	-	-	-	-	-	-	0
		Relative emphasis	-	-	-	-	-	-	-	-	
		Expected genetic gain	-	-	-	-	-	-	-	-	
	Ewes	Advantage of selected lambs	4.97	.03	.28	.42	.32	.54	-1.00	.58	25.00
		Relative emphasis	1.10	.04	.08	1.05	.97	1.17	-.87	1.04	
		Expected genetic gain	1.49	.01	-	.24	.04	.22	-	-	
15	Rams	Advantage of selected lambs	-	-	-	-	-	-	-	-	0
		Relative emphasis	-	-	-	-	-	-	-	-	
		Expected genetic gain	-	-	-	-	-	-	-	-	
	Ewes	Advantage of selected lambs	3.32	-.10	.15	.07	.32	.14	.04	.21	34.62
		Relative emphasis	.50	-.12	.06	.18	.59	.20	.11	.50	
		Expected genetic gain	.99	-.04	-	.04	.04	.06	-	-	

BODY WEIGHTS AND SCORES OF FINE WOOL, CROSSBRED YEARLING RAMS

Group No.	No. of rams	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)
12	8	109.1	2.84	1.79	2.10	2.04	1.62
14	3	112.7	3.45	1.78	1.78	1.00	2.28
15	2	131.0	3.67	2.08	2.42	1.00	2.50
Totals & Averages							
1951	13	113.7	3.10	1.84	2.07	1.38	2.05
1950	24	113.3	2.99	2.43	2.13	1.13	1.35

The body weights and scores of the finewooled crossbred yearling rams summarized in the above table were too few in numbers to justify a valid comparison between groups. Only small differences were found for any of the characteristics. The rams of group 15 had the heaviest body weights, those of group 14 the most desirable type and condition scores, and those of group 12 had the least amount of outercoat fibers.

When compared to the yearling rams in research project 2, these rams were superior in type, condition and outercoat scores, and about the same for other traits. The 1951 yearlings of this project have better average type scores than those of 1950, but in all other traits are inferior to the 1950 yearling rams.

FLEECE CHARACTERISTICS OF FINE WOOL, CROSSBRED YEARLING RAMS

Staple lengths, grades and fleece weights of yearling finewooled crossbred rams of groups 12, 14 and 15 are summarized below.

Group No.	No. of rams	Fleece weights		Fiber Traits at Side	
		Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)
12	8	9.85	3.67	60s	10.1
14	3	10.63	2.80	62s	9.2
15	2	8.62	3.08	70s	8.0
Totals & Averages					
1951	13	9.84	3.36	62s	9.5
1950	24	8.96	4.89	60s	11.2

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

The yearling rams produced fleeces that yielded considerably less clean wool than comparable breeding groups for 1950. Average grease fleece weights were 0.88 pounds heavier than those for 1950, while clean fleece weights averaged 1.53 pounds lighter. The percent yield of clean wool was thus reduced from about 55% in 1950 to only 34% for 1951. Fiber diameter grade was approximately the same, but staple length averaged 1.7 cms. shorter. The shorter staple, less clean wool, and more dirt in the fleeces are due primarily to dry range conditions and short feed of the 1950 - 1951 seasons.

BODY WEIGHTS AND SCORES OF FINE WOOL, CROSSBRED YEARLING EWES

Group No.	No. of ewes	Body weight (lbs.)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)
12	21	54.1	3.06	2.45	2.46	1.10	1.99
14	9	56.0	2.95	2.35	2.43	1.33	2.09
15	5	59.4	3.03	2.73	2.74	1.40	1.97
Totals & Averages							
1951	35	55.4	3.03	2.47	2.49	1.20	2.01
1950	49	61.8	2.76	2.22	2.13	1.14	1.68

The body weights and scores of the yearling crossbred ewes in groups 12, 14 and 15 are summarized in the preceding table. Only small differences were found between groups in any of the characteristics. When compared to the yearling crossbred ewes in research project 2, they were slightly superior in weaning weight and type and condition scores, but were excelled by the coarsewooled ewes in other traits. This was a reversal of the 1950 trend.

FLEECE CHARACTERISTICS OF FINE WOOL, CROSSBRED YEARLING EWES

Group No.	No. of ewes	Fleece weights		Fiber Traits at Side	
		Grease (lbs.)	Clean (lbs.)	Grade	Staple length (cms.)
12	21	5.00	1.91	80s	9.1
14	9	5.34	1.87	80s	10.0
15	5	4.36	1.88	80s	8.2
Totals & Averages					
1951	35	5.00	1.90	80s	9.2
1950	49	8.70	3.64	70s	9.1

1. The first part of the paper is devoted to a general discussion of the problem of the existence of solutions of the system of equations (1) for arbitrary values of the parameters α and β . It is shown that the system has solutions for all values of the parameters α and β if the function $f(x)$ is continuous and has a bounded derivative.

2. In the second part of the paper the problem of the existence of solutions of the system of equations (1) for arbitrary values of the parameters α and β is solved. It is shown that the system has solutions for all values of the parameters α and β if the function $f(x)$ is continuous and has a bounded derivative.

3. In the third part of the paper the problem of the existence of solutions of the system of equations (1) for arbitrary values of the parameters α and β is solved. It is shown that the system has solutions for all values of the parameters α and β if the function $f(x)$ is continuous and has a bounded derivative.

4. In the fourth part of the paper the problem of the existence of solutions of the system of equations (1) for arbitrary values of the parameters α and β is solved. It is shown that the system has solutions for all values of the parameters α and β if the function $f(x)$ is continuous and has a bounded derivative.

There was very little difference between the groups for the several traits measured. All groups had an average fleece grade of 80s which was a grade finer than the 1950 yearling ewes. Staple length was approximately the same as last year. Both grease fleece and clean fleece weights were considerably lower, with the clean fleece weights equalling only slightly more than half the 1950 clean fleece weights.

GRADING AND SORTING OF INDIVIDUAL FLEECES

Due to the reduced appropriations, funds were not available in 1951 for the grading and sorting of fleeces.

DISPOSITION OF 1951 WOOL CLIP

The entire 1951 wool clip, with the exception of several black fleeces, was sold to the Wool Textile Industry, Leupp, Arizona. The Wool Textile Industry is an enterprise of the Navajo Tribe. Several black fleeces were sold to individual Navajo Indians.

